

26) and an alternate embodiment "comprising at least one spray nozzle (not shown) positioned to spray a patterned discontinuous layer of tackifier." See page 9, lines 13-15. Equally significant, tackifier resin is forced into the filaments of the fibers themselves. Again there is antecedent basis in that "[t]he patterned roller is positioned such that the contact of the patterned roller with the reinforcing fibers is sufficient to force some of the resin into the fibers themselves." See page 8, lines 23-25. While not specifically discussed in the application of the present invention, the significance of this "forcing" is readily apparent in the art. Applicant has provided to the Examiner relevant portions from two text sources, *ASM Handbook, Volume 21 Composites*, or hereinafter "ASM Handbook," a compilation prepared under the direction of the ASM International Handbook Committee, and *Composites Materials Handbook*, or hereinafter "Composite Handbook," authored by M. M. Schwartz. In the ASM Handbook, fibers, such as a carbon filament, contain "tiny undulating ribbon-like structures which are intertwined and oriented more or less parallel to the axis of the [filament]." See pages 36-37, Figure 2. Similarly in the Composite Handbook, polyacrylonitrile ("PAN") fibers "are offered as yarns containing 1,000 to 12,000 filaments and tows containing up to several hundred thousand filaments." See pages 2.42-2.43, Figure 2.8. These clarifying features of the present invention are not disclosed in the prior art as will be discussed in additional detail below.

Rejection under U.S.C. 102/103

The Examiner has rejected claim 14 under both 35 U.S.C. 102(b) and 35 U.S.C. 103(a) as being anticipated by and as obvious under United States Patent No. 5,480,603 issued to Lopez, hereinafter "Lopez".

The Examiner's primary description of Lopez is contained in the rejection of claim 14 as follows:

Lopez et al suggested that it was known to provide a discontinuous tackifier film within a plurality of plies used to manufacture a perform for resin transfer molding. The reference suggested that various techniques would have been useful for the application of the discontinuous deposition of the tackifying resin within the figure layers which included the use of spraying as well as flexographic printing of the aqueous tackifier. The tackifier was in the form of particles which were disposed in an aqueous coating liquid. After drying of the aqueous coating, a discontinuous pattern of tackifier was provided within the fiber layers and between the fibers of the assembly. The fiber layers were assembled to

form a preform for resin transfer molding. It is readily apparent from a reading of Lopez that the powder tackifier was applied in a discontinuous pattern to the fiber layers (the powder stays in a discontinuous pattern after removal of the water from the aqueous liquid applied to the fibers). The reference did not expressly state that the liquid was applied in a pattern onto the fibers, however such is a processing limitation and the claims at hand are article claims. The applicant is advised that it is not possible for the Office to obtain prior art products and products of the claimed invention and make physical comparisons between the two. Because the product appears to be identical to that produced by applicant, applicant has the burden to show that the claimed processing steps would have produced a materially different product from that described by Lopez.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a preform for resin transfer molding which included a tackifier therein which was disposed throughout the fiber reinforcement in a discontinuous pattern where such application of the tackifier into the fiber layers included the application of the same via flexographic printing and gravure printing of the aqueous tackifier (which were known pattern applying techniques in the art). The applicant is specifically referred to column 1, lines 31-37 and lines 43-48 for a description of the prior art application of the tackifier and column 2, lines 11-14 and 7, lines 56-59 for a discussion of the discontinuous application of the tackifier to the fiber reinforced materials. Applicant is also referred to column 5, lines 23-29 for the various techniques used to apply the aqueous solution of the fibers. At column 2, lines 52-61, the reference suggested that the tackifier was cured in the performing operation (at least partially cured).

(emphasis added).

Applicant respectfully traverses this rejection. Claim 14, which depends from claim 1, is neither anticipated by or rendered obvious by Lopez. Since the Examiner has not maintained his section 102 rejection of claim 1 initially made in the Office Action dated May 6, 2002, claim 1 is therefore not anticipated by Lopez. Thus, claim 14, which provides but an additional limitation to claim 1, likewise cannot be anticipated by Lopez. For the reasons stated in the next section, since the Examiner is rejecting claim 1 under section 103, claim 14 is also not rendered obvious by Lopez.

However, Applicant does wish to address the Examiner's assertion above (underlined) which pertains to product by process claims, which includes claim 14. While Applicant appreciates that the product, a preform, may not visually appear to be different from one made by another, Applicant asserts such differences can be objectively determined by testing. Applicant states:

Critical to the success of the RTM process is the construction of the preform. The preform must be constructed in such a manner as to allow for handling and placement into the RTM mold. Stabilization of the preform is achieved by applying tackifier to the surface of each layer of reinforcing fibers. The amount of tackifier and its location on the layer of reinforcing fibers can greatly affect the handle ability, the stackability and the injectability of the perform.

One problem with the above described methods of applying the tackifier is that powder systems can result in a layer of powder that will not go into solution in the RTM resin, significantly reducing the mechanical properties in the final part. Continuous film spraying methods may leave too much resin on the layer of reinforcing fibers resulting in reduced RTM resin injection capability thereby weakening the final part, lack of flexibility in the preform and high potential for void formation in the final part.

(See page 3, lines 6-18; emphasis added). Lopez employs powdered tackifier that is placed in an aqueous dispersion. Applicant has specifically noted above that the presence of either of these aspects, much less both, which are provided in Lopez, clearly result in reduced mechanical properties in the final part. Since the present invention produces parts having improved mechanical properties, a preform produced by the method of claim 1, produces a materially different product from that described by Lopez. This difference can be objectively determined by testing of mechanical properties.

Thus, for the reasons listed above, (and below as to the 103 rejection of claim 1) Applicant respectfully submits that Lopez neither render anticipates nor renders obvious claim 14 of the present invention.

Rejection under U.S.C. 103

The Examiner has rejected claims 1, 2, 5-8, 11-13, 18 and 19 under 35 U.S.C. 103(a) as being unpatentable over Lopez in view of either one of Vennike or Schommer et al and optionally further with either of PCT 98/50211 or Colegrove et al.

The Examiner's primary description of Lopez contained in the rejection of claim 14 is repeated as follows:

Lopez et al suggested that it was known to provide a discontinuous tackifier film within a plurality of plies used to manufacture a perform for resin transfer molding. The reference suggested that various techniques would have been useful for the application of the discontinuous deposition of the tackifying resin within the figure layers which included the use of spraying as well as

flexographic printing of the aqueous tackifier. The tackifier was in the form of particles which were disposed in an aqueous coating liquid. After drying of the aqueous coating, a discontinuous pattern of tackifier was provided within the fiber layers and between the fibers of the assembly. The fiber layers were assembled to form a preform for resin transfer molding. It is readily apparent from a reading of Lopez that the powder tackifier was applied in a discontinuous pattern to the fiber layers (the powder stays in a discontinuous pattern after removal of the water from the aqueous liquid applied to the fibers).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a preform for resin transfer molding which included a tackifier therein which was disposed throughout the fiber reinforcement in a discontinuous pattern where such application of the tackifier into the fiber layers included the application of the same via flexographic printing and gravure printing of the aqueous tackifier (which were known pattern applying techniques in the art). The applicant is specifically referred to column 1, lines 31-37 and lines 43-48 for a description of the prior art application of the tackifier and column 2, lines 11-14 and 7, lines 56-59 for a discussion of the discontinuous application of the tackifier to the fiber reinforced materials. Applicant is also referred to column 5, lines 23-29 for the various techniques used to apply the aqueous solution of the fibers. At column 2, lines 52-61, the reference suggested that the tackifier was cured in the performing operation (at least partially cured).

Applicant respectfully traverses this rejection. As to independent claims 1 and 18, Lopez does not render obvious a method of preparing a preform for a RTM molding process or a fiber-reinforced composite article for use in a gas turbine engine comprising the steps of: forming a layer of reinforcing fibers; *applying* a patterned discontinuous *liquid* layer of a tackifier resin to at least one side of the layer of reinforcing fibers, wherein a predetermined quantity of the tackifier resin being *forced* into a number of the fibers; and curing the tackifier resin.

Lopez, as understood, utilizes an aqueous dispersion in which tackifier is the form of a solid resin and ^{is} dispersed by a surfactant in the water, which *substantially uniformly distributes* the tackifier upon application. (*emphasis added*) It is upon the removal of water from the dispersion that the discontinuous but random distribution of resin particles is achieved. As stated in one of the embodiments:

A visual examination of the dried coated plies reveals a substantially uniformly distributed discontinuous film coating of the tackifier on their surfaces.

See col. 7, lines 56-59. Applicant asserts that Lopez *applies* a substantially uniform layer of aqueous dispersion that includes tackifier, such as by a spray nozzle which results in a discontinuous but random location of tackifier only after removal of the water. This is not the present invention. Lopez does not teach or suggest a "patterned" discontinuous liquid layer. While Lopez discusses a *resulting* discontinuous layer, after removal of the water from the dispersion, Lopez does not discuss a "patterned" discontinuous liquid layer. The formation of the discontinuous coating as a result of a drying process does not provide a pattern because the location of tackifier particles cannot be controlled. Further, the present invention does not require this drying process required in Lopez. The Examiner then states that upon drying of the aqueous dispersion of tackifier, the discontinuous layer in Lopez is provided *within* the fiber layers and between the fibers of the assembly. Lopez does not disclose providing the discontinuous layer *within* the fiber. Lopez instead discloses "tackifier particles to be deposited *on* the individual fibrils" which "allow[s] the tackifier particles to be deposited *on* the individual fibrils." See col. 5, lines 39-41. Further, a coating bath discloses applying the resin *on* the fibers (see col. 5, line 50) and even upon sufficient heat being supplied to drive off water and partially melt the resin particles, the particles still are melted *on* the fibrils. See col. 5, lines 59-60. As previously stated and specifically recited in claim 1, a predetermined quantity of tackifier resin is *forced into* a number of the fibers in a pattern. Lopez lacks both the teaching of forcing the tackifier into the fibers and a pattern. Further, the present invention does not require the drying step required in Lopez.

The Examiner then states that "It is readily apparent from a reading of Lopez that the powder tackifier was applied in a discontinuous pattern to the fiber layers (the powder stays in a discontinuous pattern after removal of the water from the aqueous liquid applied to the fibers)". Applicant fails to see how it can be readily apparent that *powder* tackifier can be applied in any pattern when Lopez discloses *applying* a substantially *uniform* layer of tackifier in *aqueous dispersion*, such as by a spray nozzle. By virtue of the uniform tackifier layer being applied in an aqueous dispersion, not in powder form, the tackifier is not in a discontinuous pattern as applied, and thus, cannot "stay" in any pattern. Further, as previously discussed, the aqueous dispersion is uniform, and it is only upon drying that a discontinuous layer is formed, which by virtue of the drying process prevents the formation of a *pattern* because discontinuities cannot be controlled. As one skilled in the art understands, or one familiar with removal of water, the

drying process will provide a random distribution of particles along the entire surface, and not a patterned distribution along a preselected portion of the surface. As previously discussed, the present invention does not require the drying process required in Lopez.

Thus, contrary to the Examiner's generalized contention in his second paragraph response provided above, page 3, in connection with the claim 14 rejection starting "It would have been obvious," for reasons previously discussed, it is not only *not* obvious, but entirely inaccurate and misplaced. For example, Lopez does not disclose "form[ing] a preform for resin transfer molding which included a tackifier *therein* which was *disposed* throughout the fiber reinforcement in a *discontinuous pattern*". More accurately, Lopez discloses applying an *uniform aqueous dispersion* of tackifier resin *onto* fibers that upon drying produce a *discontinuous layer* of tackifier film coating in which the resin particles are randomly located. Lopez and Vennike or Schommer are not properly combinable. Lopez, as discussed above, teaches applying an aqueous solution uniformly and evaporating the water to produce a discontinuous unpatterned layer. Schommer or Vennike teach the application of ink or other solution, which is not a suspension as disclosed in Lopez, for application to a web of material by an impression roller. Further, Lopez fails to disclose *forcing* of the liquid tackifier resin *into* a number of fibers.

The Examiner states that regarding PCT 98/50211 and Colegrove:

Both PCT '211 and Colegrove suggested that in the manufacture of a preform for resin transfer molding one skilled in the art at the time the invention was made would have desired to apply the coating of the tackifier in a discontinuous pattern. The reference to Colegrove et al suggested the pattern would have been in the form of a grid. The reference to PCT '211 suggested that discrete spots of the tackifier would have been applied via a printing operation (see page 5, line 33- page 6, line 10). The reference to Colegrove expressly suggested that the tackifier would have been in the form of a grid. It would have been obvious to one of ordinary skill in the art at the time the invention was made to employ the coating techniques of gravure or flexographic coating as suggested was known by either one of Vennike or Schommer et al wherein the discontinuous coating of the tackifier was known to have been desirable as suggested by either one of Colegrove et al or PCT '211.

PCT 98/50211, hereinafter PCT' 211, as understood, is directed to a preform binder resin for preform manufacture. However, a portion of a passage that the Examiner has specifically cited in PCT '211 provides that the perform binder resin may be either applied in the form of free-flowing powder (page 5, line 31) or "from solution" by spraying or printing. *See* page 5, lines 34-35 to page 6, line 1. Thus, this reference is not properly combinable with Lopez as Lopez teaches applying an aqueous solution uniformly and evaporating the water to produce a continuous unpatterned layer. The resin in powder form is considered disadvantageous (see Background). Furthermore, placing the resin in solution teaches away from the aqueous dispersion taught by Lopez. Additionally, to complete the Examiner's passage, after application of the aqueous dispersion of binder resin, "upon evaporation of the solvent particles, discrete areas or islands of binder resin are formed." *See* page 5, lines 1-3. Application of resin to "discrete areas" does not, of itself, indicate a pattern, only lack of a continuous layer. Thus, PCT '211 fails to disclose applying a patterned discontinuous liquid layer of a tackifier resin.

Colegrove, as understood, discloses a method of applying a resin film grid from *a release paper* to each side of a unidirectional layer of fibers. Opposed heated rollers 14 are spaced apart to apply "sufficient pressure for the layers of resin film grid 8 (softened by the heated rollers) to **be transferred** to both sides of the unidirectionally-aligned fibers 10." *See* col. 4, lines 9-12. The fibers then pass over a heated platen 15 to **melt the resin on the fibers**, resulting in a unidirectional fiber tape. The fiber tape is then passed through a pair of "nip" rollers which removes one of the release papers prior to rolling the fiber tape onto a take-up roller. As noted by the Examiner, Colegrove discloses and is limited to a method of applying a film grid from a *release paper*. Colegrove further states that the resin is structured "to achieve a viscosity desirable for printing the resin mesh film onto paper." *See* col. 2, lines 62-65. Therefore, Applicant's further clarification in claim 1 that the tackifier resin is applied in a patterned discontinuous *liquid* layer clearly differentiates Applicant's invention from Colegrove. Applicant has antecedent basis for this construction. *See* page 3, lines 26-27.

Applicant asserts that neither Lopez, Vennike, Schommer, PCT '211 or Colegrove either alone or in combination recognize the advantage of a method of preparing a preform for a RTM molding process comprising the steps of: forming a layer of reinforcing fibers; applying a patterned discontinuous *liquid* layer of a tackifier resin to at least one side of the layer of

reinforcing fibers, wherein a predetermined quantity of the tackifier resin being *forced into* a number of the fibers; and curing the tackifier resin. The combination of the three, lacking any motivation to employ a patterned discontinuous liquid layer of tackified resin as taught by Applicant, would not yield Applicant's invention. It is clear that the Examiner can arrive at this combination to achieve Applicant's invention only after exposure to Applicant's invention. In the absence of this motivation or suggestion, Applicant submits that the combination of Lopez, Vennike, Schommer, PCT '211 or Colegrove to achieve Applicant's invention can only be reached by use of impermissible hindsight. The references must be used without the benefit of hindsight afforded by the claimed invention.

Thus, for the reasons listed above, Applicant respectfully submits that Lopez either by itself or in combination with Vennike, Schommer, PCT '211 or Colegrove do not render obvious claims 1 and 18 of the present invention.

The Examiner rejected claim 2 stating:

With respect to claim 2, both references to Vennike and Schommer suggested that a patterned roll would have been used in the coating operation when coating via flexographic coating or gravure coating.

Inasmuch as claim 2 is dependent on claim 1 providing but an additional limitation to this claim, which is believed to be allowable as discussed above, claim 2 is also believed to be allowable.

Therefore for the reasons given above, dependent claim 2 is believed to be distinguishable from Vennike and Schommer and therefore is not rendered obvious by Vennike and Schommer.

The Examiner rejected claim 4 stating:

The reference to Lopez suggested that one skilled in the art would have additionally known to apply the tackifier via a spray coating operation. The combination as addressed above additionally expressed that it was known to apply the tackifier in the perform in a discontinuous pattern, however, there is no evidence that such discontinuous pattern would have been applied via spray coating. The admitted prior art, however, expressly suggested that spray coating a continuous pattern of adhesive upon a substrate was known per se wherein the pattern applied was a discontinuous pattern, see page 9, lines 12-16 of the specification. It certainly would have been within the purview of the ordinary

artisan to utilize the conventional spraying techniques to apply a discontinuous pattern of adhesive upon the fiber plies using the known techniques admitted by applicant as known per se in the art wherein such a discontinuous pattern was suggested to have been useful in a perform and wherein it was known to apply the tackifier in liquid form from a spraying device.

Applicant respectfully traverses this rejection. The discussion of Lopez above is equally applicable to this rejection. Lopez does not apply a patterned discontinuous layer of tackifier resin. Further, inasmuch as claim 4 is dependent on claim 1 providing but an additional limitation to this claim, which is believed to be allowable as discussed above, claim 4 is also believed to be allowable.

Therefore for the reasons given above, dependent claim 4 is believed to be distinguishable from Lopez and therefore is not rendered obvious by Lopez.

The Examiner rejected claims 5-9 stating:

Regarding Claim 5, the reference to Lopez suggested the coating of a tow with the tackifier wherein the tow was clearly a plurality of unidirectionally arranged filaments.

Regarding claim 6, note that the reference to Lopez suggested the incorporation of a thermosetting resin as the tackifier.

Regarding claim 7, the reference to Lopez suggested the specified weight of tackifier applied, see column 5, lines 6-22.

Regarding claim 8, while the reference did not expressly suggest the specified volume take up of the resin of the tackifier in the perform, one skilled in the art would have readily appreciated that that the volume take up of the tackifier would have been less than 50% as the desired amount of tackifier was relatively low as one desired to incorporate a majority of resin in the injection molding operation. The ordinary artisan would have expected that the volume of the tackifier in the perform of Lopez would have fallen within the specified range of the claims. Additionally, one skilled in the art would have been expected to optimize the amount of tackifier applied in order to attain the desired effects.

Regarding claim 9, the references as set forth above in paragraph 5 suggested that one skilled in the art at the time the invention was made would have applied a pattern of adhesive which was discontinuous upon the reinforcement in the manufacture of the perform. The references, however, did not expressly state that the adhesive was applied in a herringbone pattern. However, application of

adhesive in a herringbone pattern was known per se in the art of adhesive bonding as suggested by either one of Anderson or Chandler (the applicant is referred to column 4, lines 26-33 of Anderson and column 4, lines 3-8 of Chandler. The applicant is advised that the application of the open herringbone pattern wherein adequate bonding was achieved while not applying an excessive amount of adhesive would have been understood to meet the adhesion requirements of Lopez and additionally that the coating patterned rollers of Vennike or Schommer would have been designed to provide such a pattern in the process of light of the evidence (the references to Anderson and Chandler). It would have been obvious to one of ordinary skill in the art at the time the invention was made to employ a herringbone pattern of adhesive when bonding components with a discontinuous pattern as suggested was known by either one of Anderson or Chandler in the operation of providing a pattern of adhesive for bonding a perform with a tackifier as set forth above in paragraph 5, note that the reference to Anderson expressly suggested that the use of a herringbone pattern would have provided an open pattern of adhesive which was clearly desirable in Lopez.

Inasmuch as claims 5-9 dependent on claim 1 each providing but an additional limitation to this claim, which is believed to be allowable as discussed above, claims 5-9 are also believed to be allowable. Further, as contained in the Examiner's action dated October 21, 2002, Applicant's responses to all rejections under 35 U.S.C. 103(a) involving Lopez and Alderfer, including claims 6 and 8 were confirmed by the Examiner as being fully persuasive.

Therefore for the reasons given above, dependent claims 5-9 are believed to be distinguishable from Lopez by itself or in combination with Anderson or Chandler and therefore are not rendered obvious by Lopez, Anderson or Chandler .

The Examiner rejected claims 11-12 stating:

Regarding claim 11 and 12, the reference to Lopez suggested the take up of the material on a roll after the coating operation wherein the tow would have subsequently been used in a braiding or winding operation (from a spool).

Inasmuch as claims 11 is dependent on claim 1 providing but an additional limitation to this claim, which is believed to be allowable as discussed above, and claim 12 is dependent on claim 11, claims 11-12 are also believed to be allowable.

Therefore for the reasons given above, dependent claims 11-12 are believed to be distinguishable from Lopez and therefore are not rendered obvious by Lopez.

The Examiner rejected claims 13 stating:

Regarding claim 13, the reference suggested that one skilled in the art would have cut the coated fiber material and stacked the same, those skilled in the art would have readily appreciated that cutting and stacking composite material for shipment for later processing (such as resin transfer molding) was conventional in the art of composite article manufacture and would have been within the purview of the ordinary artisan.

Inasmuch as claim 13 is dependent on claim 11 which is further dependent on claim 1 providing but an additional limitation to this claim, which is believed to be allowable as discussed above, claims 13 is also believed to be allowable.

Therefore for the reasons given above, dependent claim 13 is believed to be distinguishable from Lopez and therefore is not rendered obvious by Lopez.

The Examiner rejected claim 19 stating:

Regarding claim 19, the applicant is advised that the application of the resin in the form of an aqueous tackifier one would have forced the resin into the fiber layers as suggested by Lopez.

Applicant respectfully traverses this rejection. The discussion of Lopez above is equally applicable to this rejection. Lopez does not teach forcing resin into the fiber layers. Further, inasmuch as claim 19 is dependent on claim 18 providing but an additional limitation to this claim, which is believed to be allowable as discussed above, claim 19 is also believed to be allowable.

Therefore for the reasons given above, dependent claim 19 is believed to be distinguishable from Lopez and therefore is not rendered obvious by Lopez.

Applicant asserts that neither Lopez or any combination of Vennike, Schommer, PCT '211, Colegrove, Anderson or Chandler either alone or in combination recognize the advantage of a method of preparing a preform for a RTM molding process comprising the steps of: forming a layer of reinforcing fibers; applying a patterned discontinuous *liquid* layer of a tackifier resin to at least one side of the layer of reinforcing fibers, wherein a predetermined quantity of the tackifier resin being *forced* into a number of the fibers; and curing the tackifier resin. The combination of the three, lacking any motivation to employ a patterned discontinuous liquid layer of liquid tackified resin and *forcing* a predetermined quantity of the tackifier resin being into a number of the fibers as taught by Applicant, would not yield Applicant's invention.

It is clear that the Examiner can arrive at this combination to achieve Applicant's invention only after exposure to Applicant's invention. In the absence of this motivation or suggestion, Applicant submits that the combination of Lopez, Vennike, Schommer, PCT '211, Colegrove, Anderson or Chandler to achieve Applicant's invention can only be reached by use of impermissible hindsight. The references must be used without the benefit of hindsight afforded by the claimed invention.

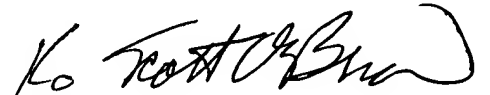
Therefore, for the reasons given above, Applicant submits that claims 1, 2, 4-9, 11-14 and 18-19 are not rendered obvious over Lopez or any combination of Vennike, Schommer, PCT '211, Colegrove, Anderson or Chandler.

CONCLUSION

In view of the above, Applicant submits claims 1, 2, 4-9, 11-14 and 18-19 are not anticipated nor rendered obvious in view of Lopez, Vennike, Schommer, PCT '211, Colegrove, Anderson or Chandler or any combination thereof. Thus, Applicant requests the withdrawal of the outstanding objections and rejections and allowance of claims and issuance of the application. A timely and favorable action is earnestly solicited.

Should the Examiner have any questions with respect to any matter now of record, the Examiner is requested to contact the undersigned at the phone number listed below.

Respectfully submitted

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